US006224133B1

(12) **United States Patent**
**Abramoski et al.**

(10) **Patent No.: US 6,224,133 B1**
(45) **Date of Patent: May 1, 2001**

(54) **SECONDARY FLOOR ASSEMBLY**

(75) Inventors: **Edward J. Abramoski**, Canton, MI (US); **Karl M. Siebertz**, Cologne (DE); **James R. Feustel**, Ann Arbor; **Brian R. Spahn**, Plymouth, both of MI (US)

(73) Assignee: **Ford Global Technologies, Inc.**, Dearborn, MI (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/186,232**

(22) Filed: **Nov. 4, 1998**

(51) **Int. Cl.**[7] ..... **B60N 3/06**
(52) **U.S. Cl.** ..... **296/75**
(58) **Field of Search** ..... 296/97.23, 193, 296/75, 191, 204, 188, 189, 203.02, 30, 194, 187

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 3,047,088 | * | 7/1962 | Murrell | 180/90.6 |
| 3,423,122 | * | 1/1969 | Wessells, III | 296/186 X |
| 3,806,184 | | 4/1974 | Dean . | |
| 3,860,284 | | 1/1975 | Lichtig . | |
| 3,904,237 | | 9/1975 | Barenyi et al. . | |
| 4,726,438 | * | 2/1988 | Stuertz et al. | 180/90.6 |
| 5,127,704 | | 7/1992 | Komatsu . | |
| 5,697,667 | * | 12/1997 | Beaudet et al. | 296/189 |
| 5,882,037 | * | 3/1999 | Bauer et al. | 296/191 X |
| 6,102,466 | * | 8/2000 | Kanazawa et al. | 296/75 |

FOREIGN PATENT DOCUMENTS

2179898 3/1987 (GB) .

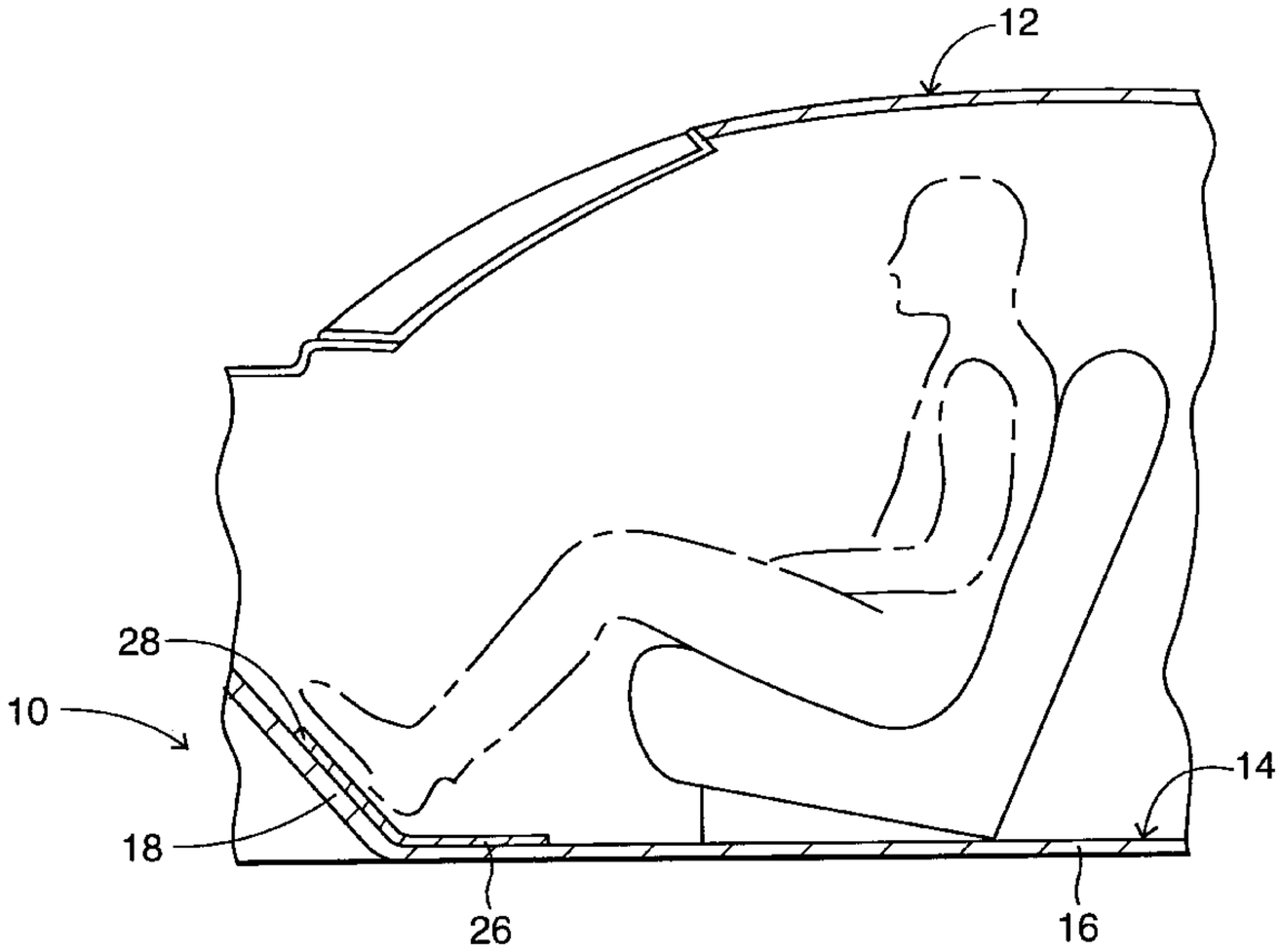
* cited by examiner

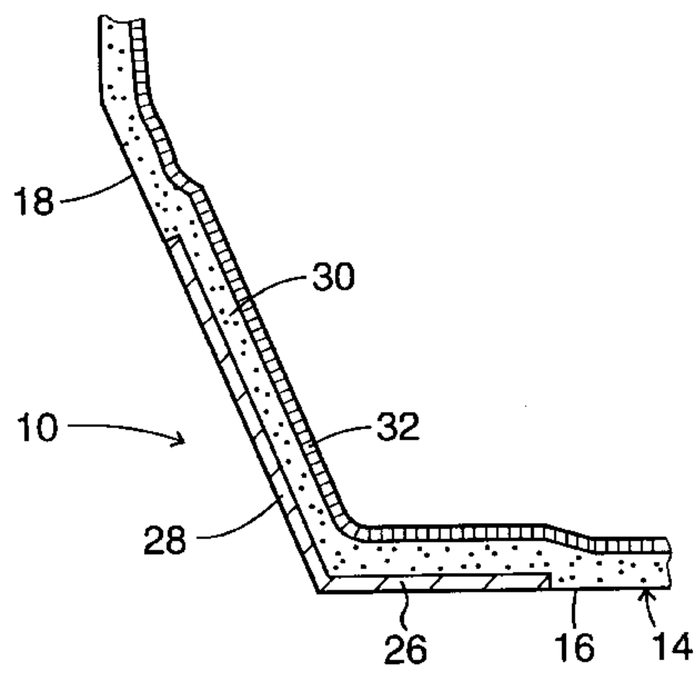
*Primary Examiner*—D. Glenn Dayoan
*Assistant Examiner*—Jason Morrow
(74) *Attorney, Agent, or Firm*—David B. Kelley

(57) **ABSTRACT**

A secondary floor assembly for a motor vehicle having a floorpan extending generally horizontally and a toeboard extending generally upwardly at an angle from the floorpan includes a heel portion extending laterally and longitudinally along the floorpan and a toe portion connected to the heel portion and extending laterally and upwardly along the toeboard for pushing a heel of a foot of an occupant of the motor vehicle rearwardly during a frontal impact of the motor vehicle.

**11 Claims, 2 Drawing Sheets**



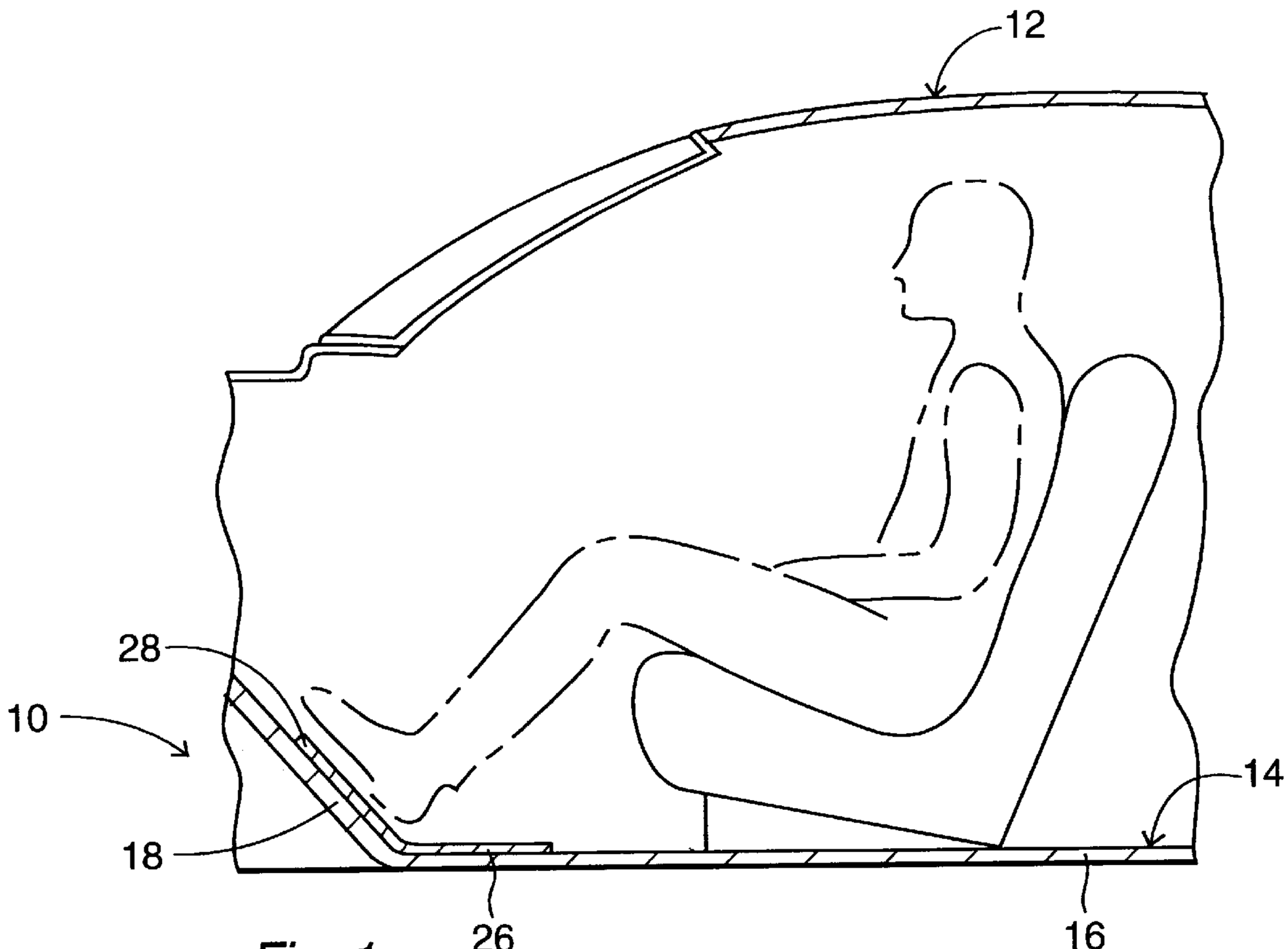



Fig. 1

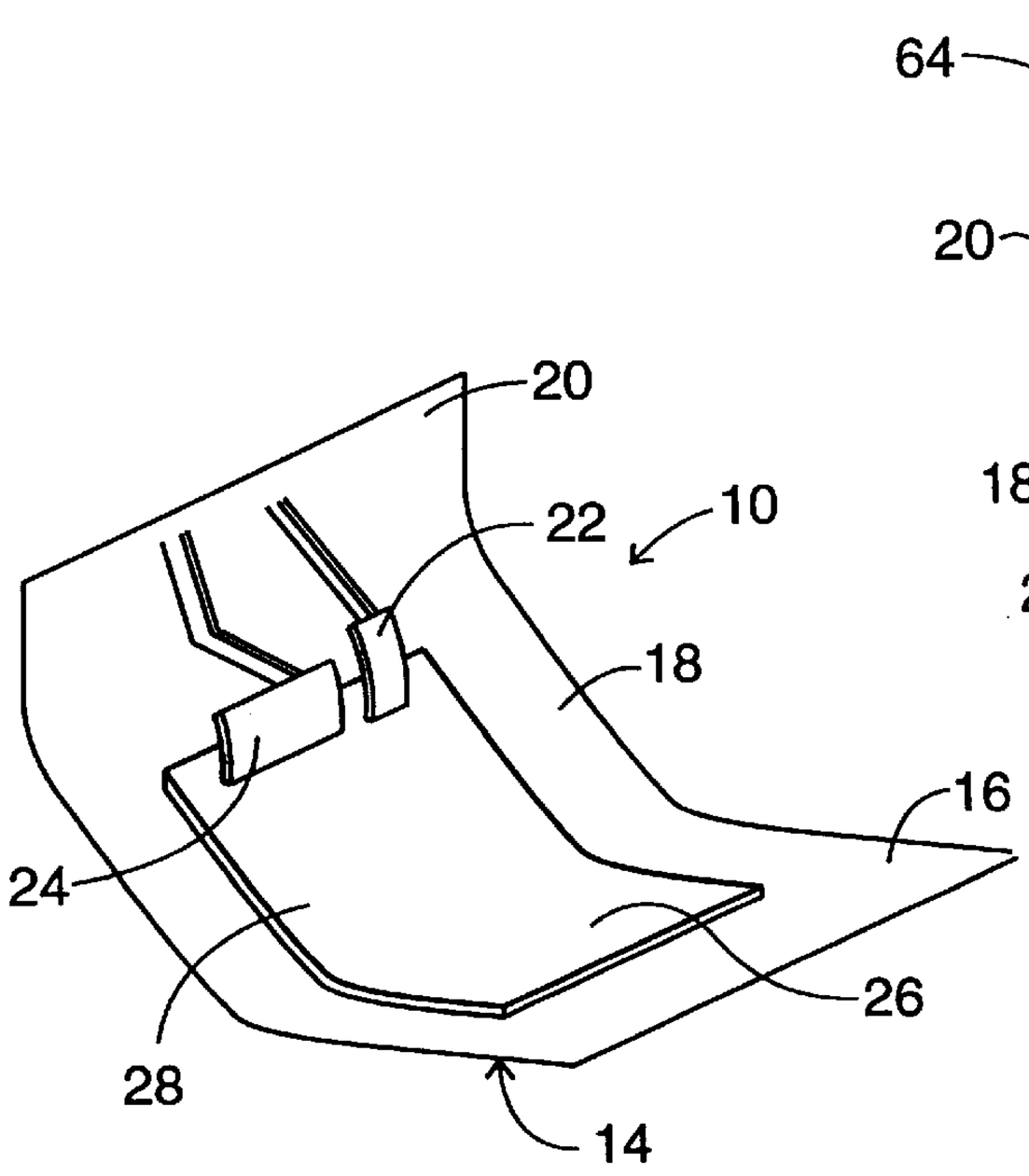



Fig. 2

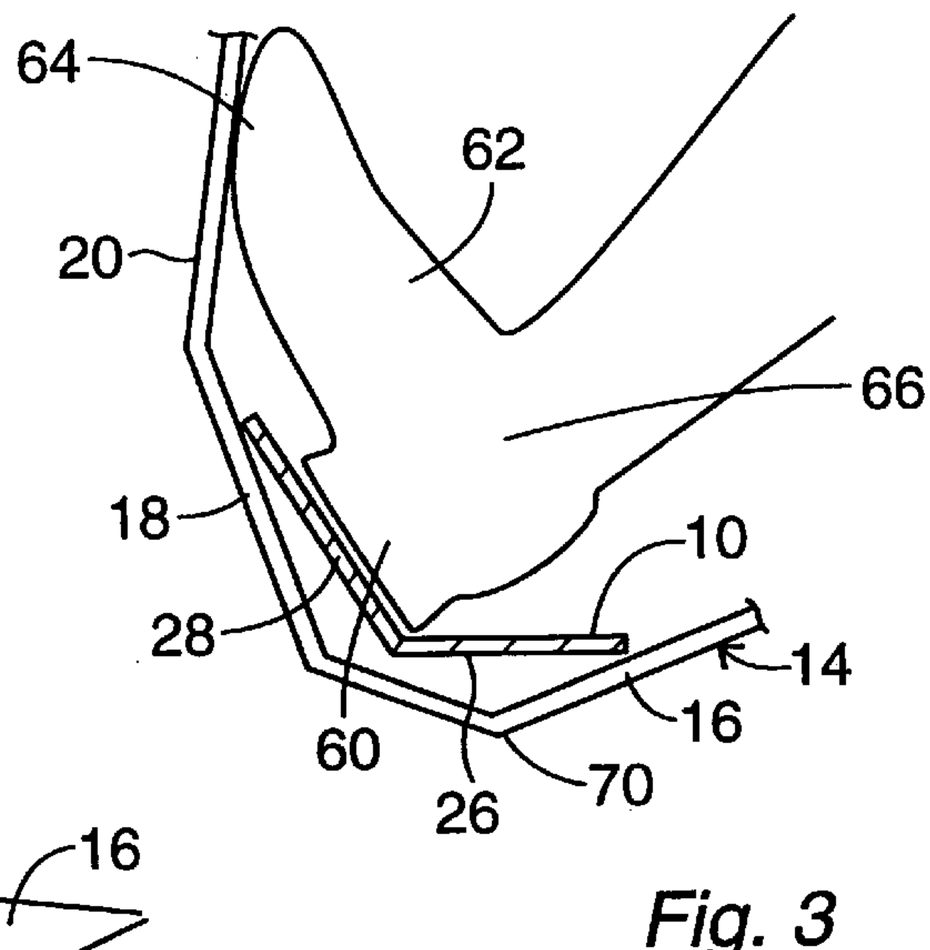



Fig. 3

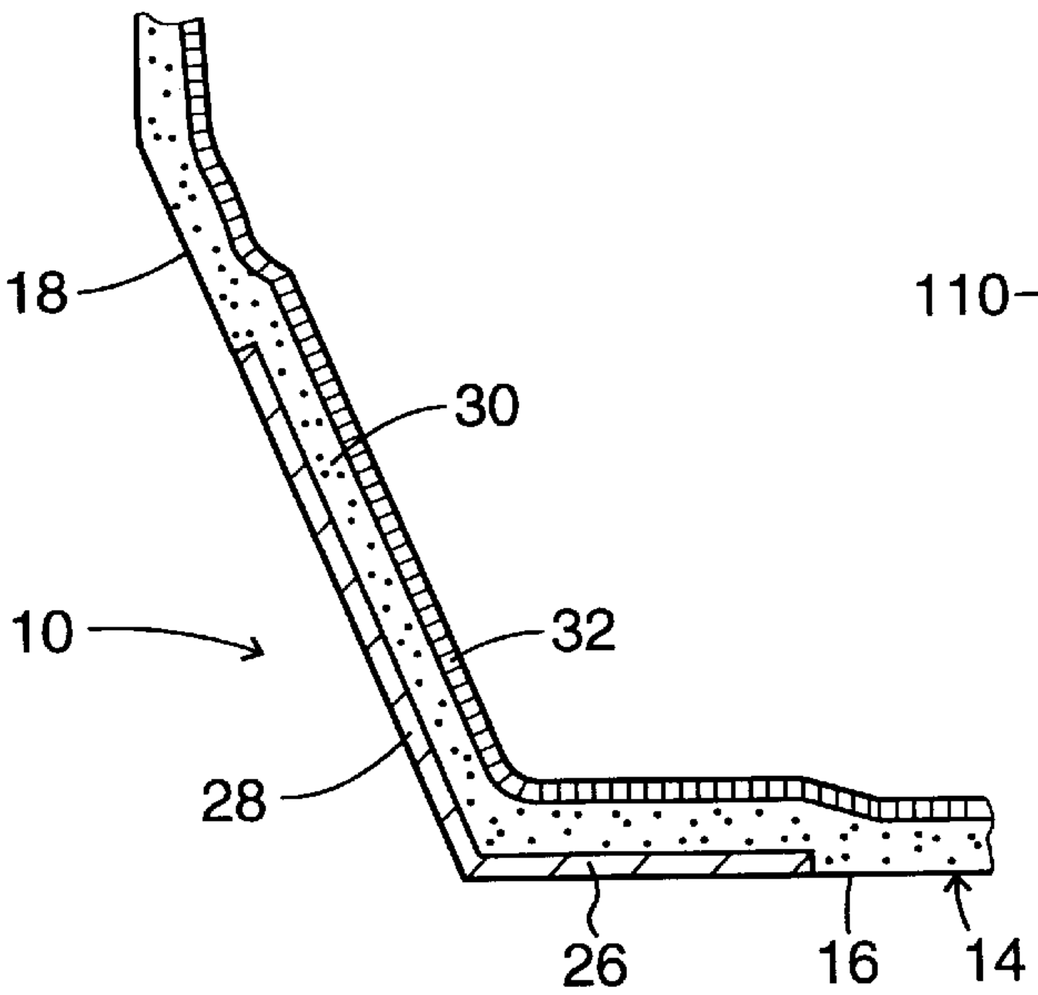



Fig. 4

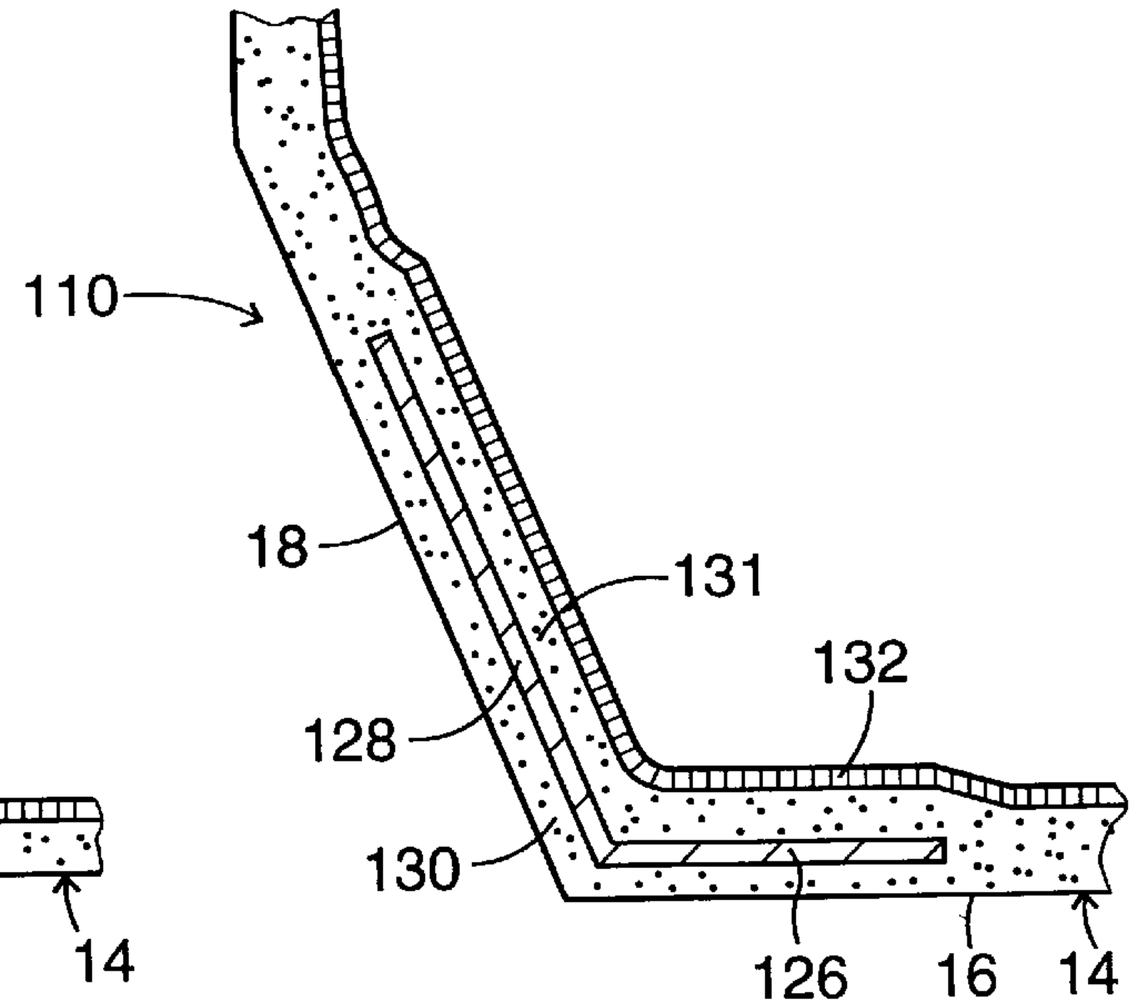



Fig. 5

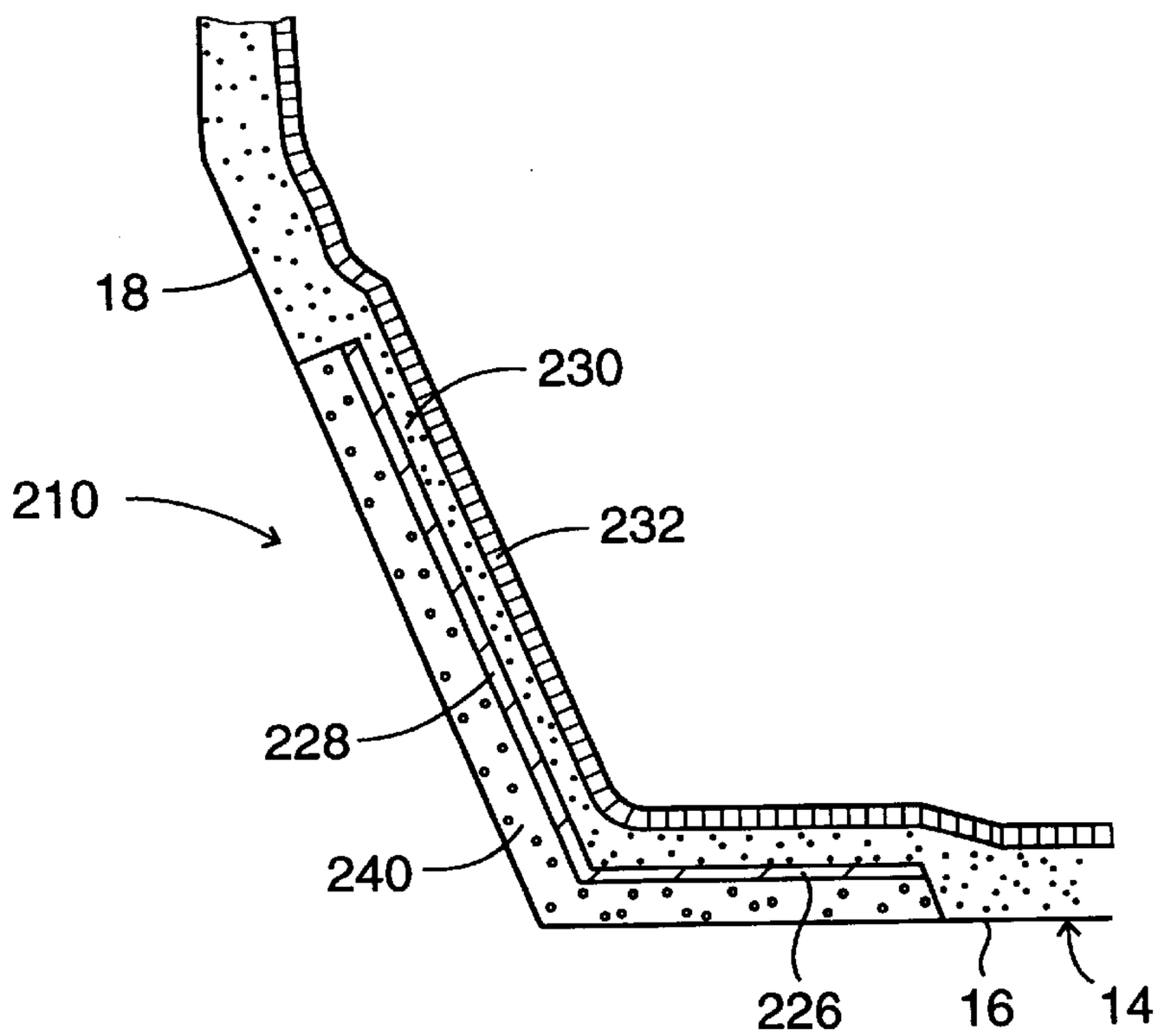



Fig. 6

# SECONDARY FLOOR ASSEMBLY

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to floors for vehicles and, more specifically, to a secondary floor assembly for a motor vehicle.

2. Description of the Related Art

It is known to provide a structural floor assembly for a body of a motor vehicle. Typically, the structural floor assembly includes a floorpan extending generally horizontally and a toeboard extending upwardly at an angle from the floorpan. The structural floor assembly also includes a dash extending generally vertically upwardly from the toeboard. Commonly, one or more pedals, such as an accelerator and brake pedal, extend from the body and generally parallel to the toeboard. Generally, the structural floor assembly is covered by carpeting.

It is known to provide a structural floor assembly with an energy absorbing material that absorbs energy during a frontal impact of the motor vehicle. The energy absorbing material covers the entire toeboard laterally and is made to absorb energy.

Although the above structural floor assembly has worked well, it suffers from the disadvantage that the energy absorbing material only resists axial loads and offers limited benefits for bending moments for an ankle of an occupant during a frontal impact of the motor vehicle. As a result, the rearward movement of the structural floor assembly may push a ball of the foot which would rotate the foot relative to a tibia, resulting in potential injury to an ankle of the occupant. Another disadvantage of the structural floor assembly is that any local deformations of the toeboard and/or floorpan could potentially result in entrapment of a heel of the foot, thereby increasing forces and moments on the foot and ankle, resulting in potential injury.

## SUMMARY OF THE INVENTION

Accordingly, the present invention is a secondary floor assembly for a motor vehicle including a floorpan extending generally horizontally and a toeboard extending generally upwardly at an angle from the floorpan. The secondary floor assembly includes a heel portion extending laterally and longitudinally along the floorpan and a toe portion connected to the heel portion and extending laterally and upwardly along the toeboard for pushing a heel of a foot of an occupant of the motor vehicle rearwardly during a frontal impact of the motor vehicle.

One advantage of the present invention is that a secondary floor assembly is provided for a motor vehicle. Another advantage of the present invention is that the secondary floor assembly is mounted on top of a structural floor assembly to reduce lower leg injury by reducing ankle rotation and inhibiting foot entrapment. Yet another advantage of the present invention is that the secondary floor assembly reduces the likelihood of foot and ankle injury during a frontal impact of the motor vehicle.

Other features and advantages of the present invention will be readily appreciated as the same becomes better understood after reading the subsequent description when taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a fragmentary elevational view of a secondary floor assembly, according to the present invention, illustrated in operational relationship with a motor vehicle.



FIG. **2** is a perspective view of the secondary floor assembly of FIG. **1**.

FIG. **3** is an elevational view of the secondary floor assembly of FIG. **2** after a frontal impact on the motor vehicle.

FIG. **4** is a fragmentary elevational view of the secondary floor assembly of FIG. **1**.

FIG. **5** is a fragmentary elevational view of another embodiment, according to the present invention, of the secondary floor assembly of FIG. **1**.

FIG. **6** is a fragmentary elevational view of yet another embodiment, according to the present invention, of the secondary floor assembly of FIG. **1**.

## DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Referring now to the drawings and in particular FIGS. **1** and **2**, one embodiment of a secondary floor assembly **10**, according to the present invention, is shown for a motor vehicle, generally indicated at **12**. The secondary floor assembly **10** is adapted to mount on top of a structural floor assembly, generally indicated at **14**, of the motor vehicle **12**. The structural floor assembly **14** includes a floorpan **16** extending laterally and longitudinally and is orientated generally horizontally. The structural floor assembly **14** also includes a toeboard **18** extending laterally and upwardly at an angle from the floorpan **16**. The structural floor assembly **14** may also include a dash **20** extending laterally and upwardly from the toeboard **18** and is orientated generally vertically. The floorpan **16**, toeboard **18** and dash **20** are made of a relatively rigid material such as metal. It should be appreciated that the floorpan **16**, toeboard **18** and dash **20** may be integral, unitary and formed as one-piece. It should also be appreciated that the structural floor assembly **14** is conventional and known in the art.

The motor vehicle **12** may also include an accelerator pedal **22** and a brake pedal **24**. The accelerator pedal **22** and brake pedal **24** are orientated generally parallel to the toeboard **28** and are connected to vehicle structure as is known in the art. It should be appreciated that the accelerator pedal **22** and brake pedal **24** are conventional and known in the art.

The secondary floor assembly **10**, according to the present invention, includes a heel portion **26** extending laterally and longitudinally over a localized area of the floorpan **16**. In the embodiment illustrated in FIG. **1**, the heel portion **26** extends laterally a distance slightly greater than a projected floor contact area where one or both feet of an occupant rests on the structural floor assembly **14**. In the embodiment illustrated in FIG. **2**, the heel portion **26** extends laterally a distance slightly greater than a distance of the accelerator pedal **22** and brake pedal **24**. In either embodiment, the heel portion **26** extends rearwardly a distance to cover the entire foot or just the heel of the foot of the occupant.

The secondary floor assembly **10** includes a toe portion **28** extending laterally and longitudinally over a localized area of the toeboard **18**. Preferably, the toe portion **28** extends laterally the same distance as the heel portion **26**. In the embodiment of FIG. **1**, the toe portion **28** extends upwardly a distance slightly greater than a distance of the entire foot of the occupant. In the embodiment of FIG. **2**, the toe portion **28** extends upwardly a distance slightly greater than the location of the accelerator pedal **22** and brake pedal **24**.

The heel portion **26** and toe portion **28** are made from either a rigid or semi-rigid material such as metal, plastic or

a high density foam/metal composite. Preferably, the heel portion **26** and toe portion **28** are integral, unitary and formed as one-piece.

Referring to FIG. **4**, the secondary floor assembly **10** may be attached to the structural floor assembly **14** by suitable means such as clips, rivets or an adhesive (not shown) . In the embodiment illustrated, the secondary floor assembly **10** may be include a first layer **30** of foam or sound absorbing material and a second layer **32** of carpeting covering the first layer **30**. It should be appreciated that any attachments to the structural floor assembly **14** would have to be separate or become disconnected so that the secondary floor assembly **10** will maintain substantially its original shape.

Referring to FIG. **5**, another embodiment **110**, according to the present invention, of the secondary floor assembly **10** is shown. Like parts of the secondary floor assembly **10** have like numerals increased by one hundred (100). In this embodiment, the secondary floor assembly **110** may include a first layer **130** of foam or sound absorbing material disposed between the structural floor assembly **14** and the toe portion **128** and heel portion **126**. The secondary floor assembly **10** may include another layer **131** of foam or sound absorbing material covering the toe portion **128** and heel portion **126**. The secondary floor assembly **10** may include a third layer **132** of carpeting covering the second layer **131**. It should be appreciated that the toe portion **128** and heel portion **126** could be embedded in a single piece of foam or sound absorbing material. It should also be appreciated that the toe portion **128** and heel portion **126** is a loose piece between the structural floor assembly **14** and the layer **132** of carpeting.

Referring to FIG. **6**, yet another embodiment **210**, according to the present invention, of the secondary floor assembly **10** is shown. Like parts of the secondary floor assembly **10** have like reference numerals increased by two hundred (200). In this embodiment, the secondary floor assembly **210** may include a support member **240** disposed between the structural floor assembly **14** and the toe portion **228** and heel portion **226**. The support member **240** is made of a foam material such as a high density foam and has the same dimensions as the heel portion **226** and toe portion **228**. The secondary floor assembly **10** may include a first layer **230** of foam or sound absorbing material covering the heel portion **226** and toe portion **228**. The secondary floor assembly **210** may also include a second layer **232** of carpeting covering the first layer **230**. Preferably, the heel portion **226** and toe portion **228** are made of a metal material. Alternatively, the support member **240** may also include a layer (not shown) of metal on the top and bottom thereof. It should be appreciated that the heel portion **226** and toe portion **228** are secured to the support member **240** by suitable means such as an adhesive.

In operation of the secondary floor assembly **10** as illustrated in FIG. **3**, when the motor vehicle **12** receives a frontal impact from an object with sufficient force, the secondary floor assembly **10** slides or rotates rearward as a unit, maintaining its shape when acted on by dash intrusion, resulting from a severe frontal impact. This rearward movement will push a heel **60** of a foot **62** of the occupant rearward during rotation of the toeboard **18** as opposed to pushing a ball **64** of the foot **62** which would rotate the foot **62** relative to a tibia (not shown), resulting in potential injury to an ankle **66** of the occupant. Further, the frontal impact on the motor vehicle **12** may cause the floorpan **16** of the structural floor assembly **14** to buckle at **70**. The rearward movement of the secondary floor assembly **10** helps to protect the foot **62** of the occupant from possible entrapment caused by the buckling or local deformation of the toeboard **18** and/or floorpan **16**. It should be appreciated that the secondary floor assembly **110** and **210** operate in a similar manner.

Accordingly, the secondary floor assembly **10** functions to reduce lower leg injury by reducing ankle rotation and inhibiting foot entrapment. The secondary floor assembly **10, 110, 210** reduces tibia moments up to approximately eighty percent, resulting in a sixty percent reduction in a lower tibia index calculation.

The present invention has been described in an illustrative manner. It is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation.

Many modifications and variations of the present invention are possible in light of the above teachings. Therefore, within the scope of the appended claims, the present invention may be practiced other than as specifically described.

What is claimed is:

**1**. A secondary floor assembly for a motor vehicle including a floorpan extending generally horizontally and a toeboard extending generally upwardly at an angle from the floorpan, said secondary floor assembly comprising:

a heel portion extending laterally and longitudinally over and along the floorpan;

a toe portion connected to said heel portion and extending laterally and upwardly over and along the toeboard for pushing a heel of a foot of an occupant of the motor vehicle rearwardly during a frontal impact of the motor vehicle; and

wherein said heel portion and said toe portion are made of a foam/metal composite.

**2**. A secondary floor assembly for a motor vehicle including a floorpan extending generally horizontally and a toeboard extending generally upwardly at an angle from the floorpan, said secondary floor assembly comprising:

a heel portion extending laterally and longitudinally over and along the floorpan;

a toe portion connected to said heel portion and extending laterally and upwardly over and along the toeboard for pushing a heel of a foot of an occupant of the motor vehicle rearwardly during a frontal impact of the motor vehicle; and

a layer of sound absorbing material disposed over said heel portion and said toe portion.

**3**. A secondary floor assembly as set forth in claim **2** including a layer of carpeting disposed over said layer of sound absorbing material.

**4**. A secondary floor assembly as set forth in claim **3** including a second layer of sound absorbing material disposed between said heel portion and said toe portion and said layer of carpeting.

**5**. A secondary floor assembly as set forth in claim **1** including a support member disposed between said heel portion and said toe portion and the floorpan and the toeboard.

**6**. A secondary floor assembly for a motor vehicle including a floorpan extending generally horizontally and a toeboard extending generally upwardly at an angle from the floorpan, said secondary floor assembly comprising:

a heel portion extending laterally and longitudinally over and along the floorpan;

a toe portion connected to said heel portion and extending laterally and upwardly over and along the toeboard for pushing a heel of a foot of an occupant of the motor vehicle rearwardly during a frontal impact of the motor vehicle;

a support member disposed between said heel portion and said toe portion and the floorpan and the toeboard; and

wherein said support member is made of a foam material.

**7**. A secondary floor assembly as set forth in claim **1** wherein said heel portion and said toe portion extend laterally a distance greater than a foot of an occupant of the motor vehicle.

**8**. A secondary floor assembly as set forth in claim **1** wherein said heel portion extends longitudinally a distance greater than a heel of an occupant of the motor vehicle.

**9**. A floor assembly for a motor vehicle comprising:

a structural floor assembly, said structural floor assembly including a floorpan extending generally horizontally and a toeboard extending generally upwardly at an angle from said floorpan; and

a secondary floor assembly disposed on top of said structural floor assembly in a projected floor contact area of an occupant of the motor vehicle for pushing a heel of a foot of an occupant of the motor vehicle rearwardly during a frontal impact of the motor vehicle, said secondary floor assembly comprising a heel portion extending laterally and longitudinally over and along a portion of said floorpan and a toe portion connected to said heel portion and extending laterally and upwardly over and along a portion of said toeboard;

wherein said sec ondary floor assembly is made of a metal/foam composite material.

**10**. A floor assembly for a motor vehicle comprising:

a structural floor assembly, said structural floor assembly including a floorpan extending generally horizontally and a toeboard extending generally upwardly at an angle from said floorpan;

a secondary floor assembly disposed on top of said structural floor assembly in a projected floor contact area of an occupant of the motor vehicle for pushing a heel of a foot of an occupant of the motor vehicle rearwardly during a frontal impact of the motor vehicle, said secondary floor assembly comprising a heel portion extending laterally and longitudinally over and along a portion of said floorpan and a toe portion connected to said heel portion and extending laterally and upwardly over and along a portion of said toeboard; and

wherein said secondary floor assembly includes a layer of sound absorbing material disposed over said heel portion and said toe portion and a layer of carpeting disposed over said layer of sound absorbing material.

**11**. A floor assembly as set forth in claim **10** including a support member disposed between said structural floor assembly and said secondary floor assembly.

* * * * *